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The XX International Grassland Congress took place in Ireland and the UK in June-July 2005.

The main congress took place in Dublin from 26 June to 1 July and was followed by post congress satellite workshops in Aberystwyth, Belfast, Cork, Glasgow and Oxford. The meeting was hosted by the Irish Grassland Association and the British Grassland Society.

Proceedings Editor: D. A. McGilloway

Publisher: Wageningen Academic Publishers, The Netherlands

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The effects of the growth stage and inoculant on fermentation and aerobic stability of whole-plant grain sorghum silage

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Keywords: grain sorghum, stage of development, lactic acid bacteria, nutritional quality, aerobic stability

Introduction Grain sorghum (*Sorghum bicolor*) is well adapted to environments with limited rainfall and low soil fertility. Today, on dry land, improved grain sorghum hybrids may be a valid alternative to maize silage and they may give DM yields and digestible energy that are comparable to maize, but at lower production costs (Legarto, 2000). Harvesting crops for silage at an early stage of maturity (low DM content) may result in silage with a higher acid content and low nutritional quality, while harvesting crops at a later stage of maturity may make the forage more difficult to chop and pack. Furthermore, drier silage could be more aerobically unstable during the feed-out phase. The aim of this work was to determine the optimum stage of development for silage purposes and to evaluate the effect of maturity and lactic acid bacteria (LAB) inoculant on the fermentation, nutritional quality and aerobic stability of whole-plant silage produced by grain sorghum grown without irrigation in the Po valley, NW Italy.

Materials and methods White grain sorghum (cv. Kalblanc), sown on 25 May 2002 and grown without irrigation, was harvested at 4 progressive morphological stages (early soft dough, I; late soft dough, II; early hard dough, III; and late hard dough, IV) about every 12 d from 9 August to 24 September. Sorghum was chopped and directly ensiled in 30-l laboratory silos with an inoculant (I) (*Lactobacillus plantarum*) and without an inoculant (C). The silages were analysed for the fermentation and nutritional quality after 150 d of conservation. After opening, change in temperature was measured to evaluate the aerobic stability.

Results The mean fermentation and quality characteristics of whole-plant grain sorghum silages are reported in Table 1. All silages were well fermented with no butyric acid and low contents of ammonia. Fermentation was restricted as the DM content at ensiling increased. The silages prepared from forage harvested at the early soft stage had a significantly higher value of lactic acid than the silages made at the three subsequent stages. No effect of LAB inoculant was observed on fermentation. The starch content increased, while the NDF and ADF contents decreased with advancing maturity as a result of the increase in grain content. The aerobic stability was in excess of 86 h in the first 3 stages of maturity, while it dropped to less than 55 h in the IV stage.

Table 1 Composition of control (C) and inoculated (I) grain sorghum silages at four stages of growth

Stage of growth Inoculation	I		II		III		IV		S ¹	I	S x I
	C	I	C	I	C	I	C	I			
DM (g/kg)	208	221	265	255	264	294	295	299	***	NS	NS
PH	3.7	3.8	4.0	4.1	4.0	4.1	4.0	4.0	***	**	*
Lactic acid (g/kg DM)	87	86	59	57	55	48	49	51	***	NS	NS
Acetic acid (g/kg DM)	14	9	14	16	15	14	10	9	***	NS	**
Butyric acid (g/kg DM)	0	0	0	0	0	0	0	0	-	-	-
NH ₃ -N (g/kg total N)	95	75	102	105	95	95	84	66	***	**	*
CP (g/kg DM)	94	97	91	81	72	78	75	79	***	NS	***
Starch (g/kg DM)	57	25	266	223	257	282	318	333	***	NS	NS
NDF (g/kg DM)	592	604	430	475	463	419	417	376	***	NS	*
ADF (g/kg DM)	368	364	266	303	296	261	261	238	***	NS	*
Aerobic stability (h)	86	110	>166	>166	96	>166	54	55	***	***	***

¹ S = stage of growth, I = inoculation; NS = $P > 0.05$; * = $P < 0.05$, ** = $P < 0.01$; *** = $P < 0.001$.

Conclusions The results show that grain sorghum harvested at a hard dough stage makes excellent silage with or without LAB inoculant, and is comparable in nutritional and fermentation quality to maize silage. The highest content in starch and the lowest fibre content were reached at late dough stage, close to physiological maturity, but silage was more prone to aerobic deterioration.

References

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